Topic 1: Introduction to Intelligence computational

Goals:

- Present the Computational intelligence Y their foundations and scientific-technical discipline. Understanding the
- IC as a whole based on "number crunching" to develop systems exhibiting "intelligent" behavior techniques.

- Knowing fields of application of the IC. Explore and analyze techniques based on IC solutions. Discuss some future challenges

Study this topic ...

- AP Engelbrecht, Computational Intelligence. An Introduction Second Edition. *J. Wiley, (2007).*
- L. Rutkowski, Computational Intelligence: Methods and Techniques. *Springer Verlag (2008).*
- Amit Konar; Computational Intelligence. Principles, Techniques and Applications. *Springer Verlag. (2005)*
- J. Pérez Muñoz, Computational Intelligence inspired life, *PublicacionesUMA Service (2010).* http://riuma.uma.es/

links

- http://decsai.ugr.es
- http://www.aaai.org
- www.aisb.org.uk
- http://www.lsi.upc.edu/atica/
- https://sites.google.com/site/tc3023/apuntes
- http://www.unidaddebiofisica.org/juanma/apuntes.htm # 1

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- http://www.it.uc3m.es/rcrespo/docencia/irc/
- http://www.um.es/molecula/anucl03.htm
- http://www.dma.fi.upm.es/java/fuzzy/tutfuzzy/indice.html
- http://www.youtube.com/watch?v=OP57M2Xz9QM
- http://www.youtube.com/watch?v=mgnzX5a5gIo

What does it mean to be smart?

- **What is intelligence?**
  - It is difficult to define **intelligence** in a particular way.
  - According SAR are 7 different definitions:

one. Ability to understand or comprehend.
2. Ability to solve problems.
3. Knowledge, understanding, act of understanding.
Four. Sense that you can make a judgment, a saying or expression.
5. Ability, skill and experience.
6. Treatment and secret correspondence of two or more persons or nations together.
7. purely spiritual substance.

Methods in Artificial Intelligence

Intelligence:

1) Ability to quickly find a suitable solution which in principle is an immense space of alternatives.

1) Ability to solve problems or make products that are valued in one or more cultures (H. Gardner).

What does it mean to be smart?

- H. Gardner Intelligence is not a monolithic overall capacity but that there are several (up to 7-9) forms of intelligence, which need not manifest together in one human being.

What does it mean to be smart?

- **Linguistic intelligence:** ability to use words effectively, by manipulating the structure and language syntax, phonetics, semantics, and its practical dimensions.

- · **Physical and kinesthetic intelligence:** ability to use one's body to express ideas and feelings, and particularities of coordination, balance, dexterity, strength, flexibility and speed as well as perceptive, tactile and haptic.

What does it mean to be smart?

- ·**Logic and mathematical intelligence:** ability to handle numbers, patterns and logical relationships effectively, as well as other functions and other such abstractions.

- · **Spatial intelligence:** ability to appreciate certain visual and spatial image of the ideas represented pictorially and sensitize color, line, shape the figure, the space and relationships.

What does it mean to be smart?

- **Musical intelligence:** ability to perceive, discriminate, transform and express the length, height, intensity and timbre of musical sounds.

- ·**Interpersonal / emotional intelligence:** possibility of distinguishing and perceiving the emotional states and interpersonal signs of others, and to respond effectively to such actions practical way.

- **Intrapersonal intelligence:** ability to introspection, and acting with that knowledge, to have a successful self-image, self-discipline and ability, understanding and self-esteem.

What does it mean to be smart?

Gardner then add the

- **Naturalist Intelligence:** ability to understand that the human being is part of an interconnected whole called Nature.

Others have added:

- **Intelligence religious ethics,**
- **Existential Intelligence,**
- **Existential Spiritual intelligence .....**

What is the IA?

- It is difficult to define which characterizes the IA in its entirety.
- Try to approach from the terms "intelligence" and "Artificial" is a futile attempt.
- There are many definitions of IA

What is the IA?

- **Defining IA according to AAAI (*Association for the Advancement of Artificial Intelligence, www.aaai.org):** _____

scientific and technical discipline concerned with the understanding of the mechanisms underlying thought and intelligent behavior and their incorporation into the machines.

very symbolic approach

"Traditional" computing

Boolean logic

Methods in Artificial Intelligence

If we remember that Intelligence:

Ability to quickly find one
suitable solution which in principle is an immense space of alternatives.

Methods in Artificial Intelligence

- **THE SEARCH** it appears as something that should make all (or most) system that pretend to manifest intelligent behavior.

- Search brute force (computing power of a computer) has proven to be useless except for very simple problems.

- Search brute force is not the way to solve human problems. we use **KNOWLEDGE**

Methods in Artificial Intelligence

- ***Knowledge Principle:***

A system exhibits intelligent behavior, because
mainly to knowledge that can handle: concepts, facts, representations, methods, models, metaphors and heuristics in its domain of action

- ***IA = Search with knowledge about the problem to solve***

Computational Intelligence

AI "classic" successfully addresses on:

or Problem resolution,

or Games,

or Diagnosis (abduction),

or Process control,

or Robotica, etc.

always based on the symbolic representation and manipulation of expert knowledge.

Computational Intelligence

Traditional methods of AI to solve

problems represent states system using symbols and builds a set of rules (Boolean) to describe transitions between said states.

The knowledge base is enriched with a large

number of rules but also the search time may be responsible for degradation and reasoning system deficiency.

Computational Intelligence

In the late eighties and it is considered that the IA based symbolic approach had not had the expected success.

- There are unresolved problems,
- Computers allow non-symbolic learning and simulation of biological processes
- Data play a crucial role, appearing in massive amounts.

It appears the idea of **Computational intelligence** based on data management rather than handling symbols.

Computational Intelligence

"Intelligent" behavior arises from:

- fast processing of large amounts of data massively parallel way.

- Learning and "evolution" to better match the objectives.

- Robust data management with large amounts of non-random noise uncertainty.
- Automatic configuration networks and automatic reconfiguration as the system has been damaged or destroyed.

- High degree of autonomy.

Computational Intelligence

- Many organisms including humans have the above skills and have therefore been a source of inspiration to develop more efficient techniques and algorithms.

- With such inspiration has emerged as a discipline **Computati Intelligence.**

Computational Intelligence

Since the end of the 60s (even before) they were appearing approaches inspired by nature:

- models and machine learning techniques such as **neural networks,**
- models for the representation of ambiguous knowledge and imitation of the thought processes with vague and imprecise information by **diffuse logic.**
- techniques and algorithms computing inspired mechanisms of biological evolution, **evolutiona computation**
- techniques and algorithms inspired by the behavior of the swarm of social organizations, **swarm intelligence,**
- techniques and algorithms inspired by the behavior of the immune system,
- etc.

Computational Intelligence

- The IC deals with the theory, design, development and applications of linguistic and biologically motivated computational paradigms, focusing on neural networks, genetic algorithms, evolutionary programming, fuzzy systems and hybrid intelligent systems.

- HF study problems for which no effective algorithms, either because it is not possible to formulate them or because they require a time of exponential execution
- In contrast to classical AI focused on bringing expert knowledge to the computer, the IC is conceived as an operation of the data provided by the environment.

Computational Intelligence Paradigms

There are various proposals of the paradigms that may be included IC:

- **Artificial neural networks**
- **Evolutionary computation**
- Swarm intelligence
- Artificial Immune Systems
- **Fuzzy systems**
- Probabilistic methods
- Unsupervised Classification Systems

http://www.lsi.upc.edu/atica/

Computational Intelligence Paradigms

Each of these paradigms is inspired by some system or biological behavior.

- ANN: modeling neurological system,
- EC: modeling natural evolution,
- SI: models the behavior of insects (animals) social,
- AIS is inspired by the immune system (human)
- FS: modeling the way humans (and other organisms), interact with each other and with the atmosphere,
- ML: encapsulates forms of autonomous learning

Differences between classical IA and IC

- The source of knowledge. AI is based on the representation of the expert knowledge of a certain domain, the IC extracts the knowledge of available data.
- Processing mechanisms. IA uses symbolic reasoning methods lie when the IC is based on numerical methods.

- Interactions with the environment. AI adjusts the environment to known solutions, represented by static knowledge bases, while the IC uses any data to learn from the environment and create new knowledge.

IC Application Areas

Each IC paradigm is especially suitable for a number of application areas.

However a certain application can be tackled from two different paradigms that can be combined to produce even better results (P. and. the systems neurofuzzy)

IC Application Areas

Neural networks:

1. Regression and Classification
2. Cluster and Compression
3. Generating Associative Memories
4. Generation Sequence Patterns
5. Building Control Systems
6. Etc.

IC Application Areas

Evolutionary Computation:

1. Optimization
2. Classification

3. Automatic Programming
4. Artificial Life
5. Etc.

IC Application Areas

Diffuse logic:

1. Expert Systems
2. Decision Support Systems
3. Control Systems
4. Etc.

IC Application Areas

Based on swarm intelligence systems:

1. Problems shortest path in graphs
2. Problems of optimal routing in telecommunications networks

3. Planning and Task Assignment
4. Cluster and optimization of structures
5. Etc.

IC Application Areas

Artificial Immune System:

1. Pattern Recognition
2. Classification
3. Clustering
4. Detecting Anomalies
5. Etc.

Computational Intelligence Challenges

- Develop systems of representation, storage and retrieval of increasingly closer to the human brain associative knowledge.

- Develop systems capable of evolving, self-assess and improve autonomously.

- Improve computing platforms providing them with greater capacity and speed for data management. DNA computers or quantum computation may be alternatives to this

Computational Intelligence Challenges

- Approach using computational systems:
  - The ability of biological beings to perform complex tasks without measurements or computations,
  - The human ability to reason talk, make decisions, etc. from imprecise, uncertain and incomplete information.